TEXAS A&M ENGINEERING EXPERIMENT STATION
NUCLEAR SCIENCE CENTER

TEXAS A&M UNIVERSITY

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March 3, 2016 2016-0011
Ref: 10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington DC 20555

SUBJECT: SUPPLEMENT TO LICENSE AMENDMENT REQUEST DATED OCTOBER 14, 2015, FACILITY LICENSE R-83, DOCKET NUMBER 50-128. (ADAMS ACCESSION NO. ML15287A148)

Attn: Mr. Alexander Adams, Jr., Chief,
Research and Test Reactors Branch
Office of Nuclear Reactor Regulation

Mr. Patrick M. Boyle, Project Manager,
Research and Test Reactors Branch
Office of Nuclear Reactor Regulation

The purpose of this letter is to provide supplemental information to clarify and enhance the October 14, 2015 license amendment request (LAR) and revised License and Technical Specification pages (ADAMS Accession No. ML15287A148), the subsequent Request for Additional Information (RAI) dated November 2, 2015 (ADAMS Accession No. ML15302A018), and the Texas A&M Engineering Experiment Station (TEES) response dated November 18, 2015 (ADAMS Accession No. ML15322A354). The October 14, 2015 license amendment request was submitted to change the licensing basis for the NSC Facility and amend the License and Technical Specifications to allow the receipt, possession, but not use of the AGN-201M SNM in the NSC Fuel Storage Vault. Information provided in the RAI response and this supplement does not change the conclusions reached relative to the significant hazards consideration and the environmental impact.

Movement of the AGN-201M will occur in two distinct phases: the first is to relocate the fuel and other special nuclear material (SNM) from the current AGN location to the NSC Fuel Storage Vault and the second is to remove all remaining AGN-201M components to the NSC site for long term storage while the project plan to construct a new reactor facility to house the reconstructed AGN-201 M reactor is implemented. The fuel and other SNM, together with associated byproduct material (e.g., fission and activation products in the fuel), will be received, possessed, but not used under the NSC Facility Operating License No. R-83. Byproduct material not contained in or on fuel-bearing components will continue to be possessed under the AGN-201M Facility Operating License R-23 during storage on the NSC site. This point is

addressed further in the LAR for the AGN-201M Facility Operating License No. R-23 submitted on November 11, 2015 (ADAMS Accession No. ML1531A027).

TEES is seeking approval of the October 14, 2015 license amendment request by the end of March 2016. TEES believes this short time to review the License and Technical Specification Change Request is achievable as this request contains no increased risk or impact above the currently designed, analyzed, and approved NSC reactor license. TEES notes that the proposed receipt, possession, but not use, of the AGN-201 M fuel and other SNM at the TEES NSC facility does not constitute a concern to public health and safety.

Prior to undertaking efforts to support the engineering, design and construction of a new building to house the reconstructed AGN-201M, several important actions must be completed. One action to be resolved in the near term is bringing closure to the July 30, 2013 Confirmatory Action Letter No. EA-2013-154 (ADAMS Accession No. ML13189A058). Secondly, the ongoing License Renewal efforts should be put on hold until the efforts associated with the new building can be merged with the License Renewal completion efforts. Third, the AGN-201M License and the NSC Facility License each have a Safety Analysis Report (SAR) which is required to be updated to reflect the current configuration of each reactor. Once the AGN-201M has been relocated to the NSC Facility site, both SARs shall be revised to reflect the changes, as required by 10 CFR 50.71(e).

Should you have any questions regarding the information provided in this submittal, please contact me or Mr. Jerry Newhouse at (979) 845-7551 or via email at mcdeavitt@tamu.edu or newhouse@tamu.edu.

Oath of Affirmation
I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Sincerely,

Sean M. McDeavitt, PhD.
Director, TEES Nuclear Science Center

Attachment: Supplemental Information

Enclosures:
1A Current License
1B Proposed License Changes
2A Current Technical Specification
2B: Proposed Technical Specification Changes

Debra Greer
3-3-16

Debra Greer
Notary Public,
State of Texas
Expires: 06/01/2019

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cc:

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Office of Nuclear Reactor Regulation

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Dept. of State Health Services
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Technical Advisor
Office of Permitting, Remediation & Registration
Texas Commission on Environmental Quality
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Test, Research and Training Reactor Newsletter
P.O. Box 118300
University of Florida
Gainesville, FL 32611-8300

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Supplemental Information to License Amendment Request dated October 14, 2015, Facility License R-83, Docket Number 50-128. (ADAMS Accession No. ML15287A148)

Relocation and storage of a nuclear reactor is a rare occurrence. To assist with preparations to relocate and store the AGN-201M reactor, Texas A&M University/Texas A&M Engineering Experiment Station (TAMU/TEES) has reviewed a similar possession approval requested and granted to the Oregon State University (OSU) facility for storage of its AGN-201 fuel in their TRIGA Reactor Fuel Storage Vault. The planned activity includes requesting the AGN-201M special nuclear material (SNM) be received, possessed, but not used in the NSC Fuel Storage Vault. This requires approval of the October 14, 2015 License Amendment. The duration of the storage of the fuel and special nuclear materials in the NSC Fuel Storage Vault will be no longer than 5 years, to allow for approval of the Construction Permit and completion of construction of a new building adjacent to the NSC site. Once the new facility is completed, and pending receipt of Commission approval, the AGN-201M reactor will be assembled in its new licensed location. TAMU AGN-201M fuel and other SNM contained in the TEES NSC Fuel Storage Vault will be relocated to the new AGN-201M reactor facility for installation. This will reconstitute the original reactor licensing basis.

The following information has been generated to supplement the Amendment Request of October 14, 2015. Information obtained from experts in this field and discussions with NRC Staff have led to the conclusion that enhancement is required to ensure the docket is complete and easily reviewable by the NRC staff. The SAR will be updated to reflect this information upon approval of the October 14, 2015, amendment request to address the receipt, possession, but not for use, of the AGN-201M fuel, special nuclear materials and components. The current AGN-201M Safety Analysis Report uses multiple terms when referring to the reactor fuel and the control rods. This will be addressed further in the next revision to the SAR and in coordination with the License and Technical Specifications.

The purpose of the October 14, 2015 License Amendment is to allow the TEES NSC facility to receive, possess, but not use the AGN-201M fuel, SNM, and components currently authorized under license R-23, Docket 50-59. The storage of all components will be in accordance with the current NSC license basis. Enclosures 1A and 1B are the current and proposed NSC License pages. Enclosures 2A and 2B are the current and proposed NSC Technical Specification pages that address receipt, possession, but not use, of the AGN-201M fuel, SNM, and components. The following sections contain additional clarification for issues associated with receipt, possession, but not use, of the AGN-201M fuel, SNM and components at the NSC facility.

Security Plan:

TEES has reviewed the NSC (TEES) Security Plan and finds that the proposed changes to allow TEES to receive, possess, but not use the AGN-201M fuel, SNM and components at the NSC facility does not constitute a change or decrease of the safeguards effectiveness of the NSC (TEES) Security Plan in accordance with 10 CFR 50.54 (p)(1,2), and does not require prior NRC review and approval. TEES will maintain all records of any proposed changes to the NSC Security Plan in accordance with 10 CFR 50.54 (p)(1,2). Accordingly, no changes to the NSC (TEES) Security Plan are required.

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Emergency Plan:

TEES has reviewed the NSC (TEES) Emergency Plan and finds that the proposed changes to allow TEES to receive, possess, but not use the AGN-201M fuel, special nuclear material and components does not result in reducing the capability to perform an emergency planning function in the event of a radiological emergency, in accordance with 10 CFR 50.54 (q) (iv) (3). Accordingly, no changes to the current NSC (TEES) Emergency Plan are required.

Use of the term borated aluminum is not discussed in the SAR:

TEES is providing the following information supplemental to the November 18, 2015 response (ADAMS Accession No. ML15322A354) to the NRC Staff Request for Additional Information (RAI) dated November 2, 2015 (ADAMS Accession No. ML15302A018). More specifically, the following information pertains to Item 1 concerning reactivity of the stored AGN-201M fuel in the NSC fuel storage vault and the use of a borated aluminum neutron absorber. Given the low reactivity values conservatively calculated for the two 5-gallon SNM storage drums, the use of borated aluminum is unnecessary for the safe storage of the AGN-201M fuel. Similar to the use of the cadmium sheets in the original NSC fuel storage vault design, borated aluminum will be utilized as an additional defense-in-depth provision in the storage drums in a manners shown schematically in Fig.1, but the reactivity impact from this material is not credited in the reactivity calculations shown below.

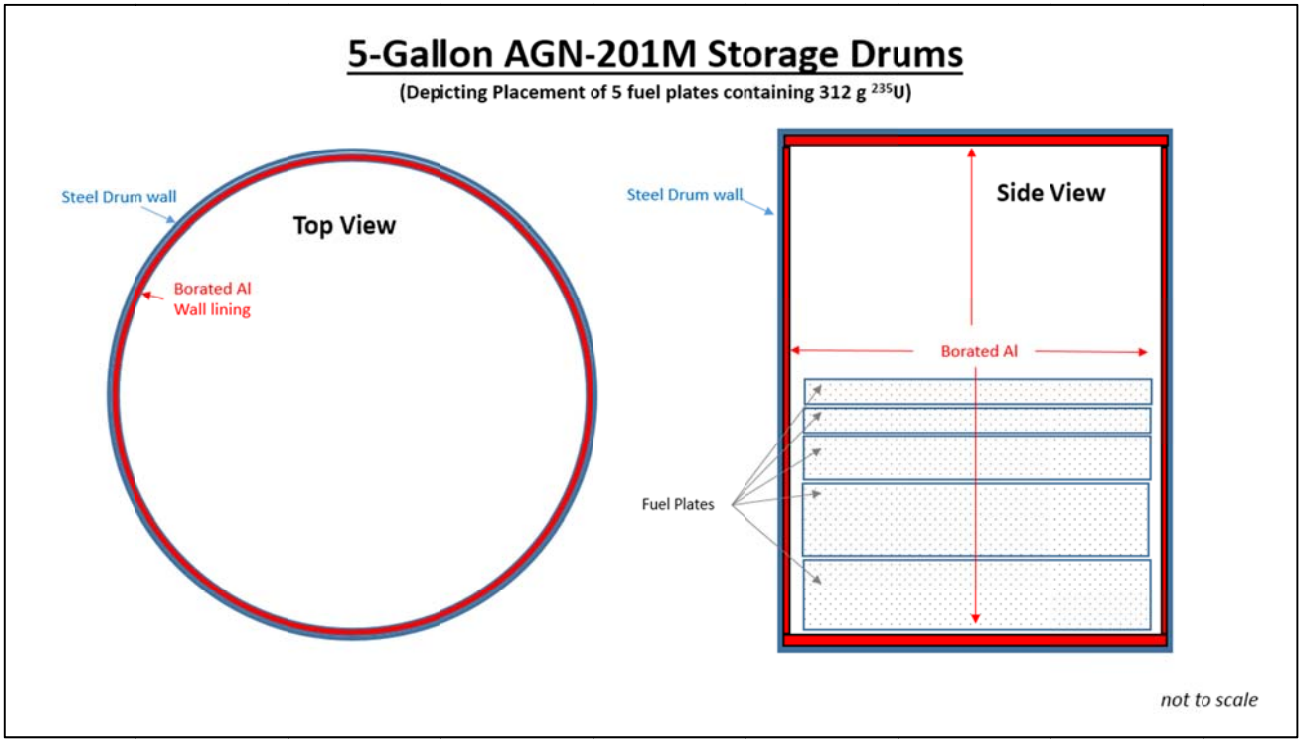

Figure 1. Nominal configuration of the storage drums to be used for SNM storage.

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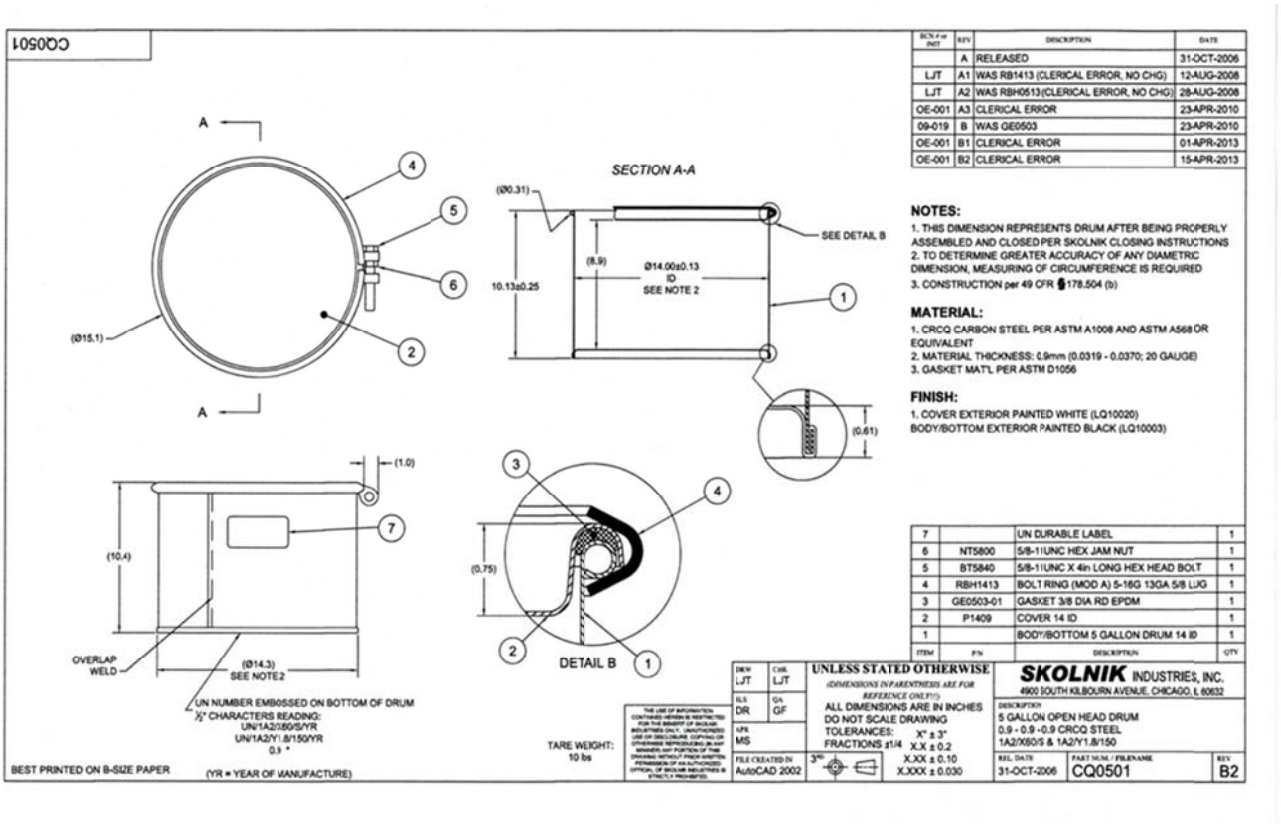
Nominal specifications for the inserts include aluminum containing 16% (or greater) B_4C at thicknesses ranging from approximately 1/8" to 3/8", Top and bottom absorber plates, and a cylinder fitted to the inside wall of the drum (Fig. 1). The NSC SAR will be updated to reflect this information upon approval of the October 14, 2015 amendment request to address receipt, possession, but not use, of the AGN-201M fuel special nuclear materials and components.

TEES is providing the following information supplemental to the November 18, 2015 RAI Item 1 response concerning calculation of reactivity of the stored AGN-201M fuel in the NSC fuel storage location. As noted above, TEES will not take credit for the presence of the neutron-absorbing borated aluminum lining that will be placed inside the 5-gallon storage containers. The 5-gallon storage containers (bolted-ring drums) have the following nominal specifications (refer to Figure 2): 14.3" outside diameter, 10.4" outside height, with 20 gauge wall thickness, and a 3/8" diameter gasket. The fuel plates will be separated into 2 roughly equal stacks for packaging (one at 312 g, one at 310 g). Note that the core thermal fuse containing 0.4 g ^{235}U will be placed in the 310 g drum.



REV	DESCRIPTION	DATE
A	RELEASED	31-OCT-2006
A1	WAS RB1413 (CLERICAL ERROR, NO CHG)	12-AUG-2008
A2	WAS RBH0513(CLERICAL ERROR, NO CHG)	28-AUG-2008
A3	CLERICAL ERROR	23-APR-2010
B	WAS GE0503	23-APR-2010
B1	CLERICAL ERROR	01-APR-2013
B2	CLERICAL ERROR	15-APR-2013

ITEM	P/N	DESCRIPTION	QTY
7		UN DURABLE LABEL	1
6	NT5800	5/8-11UNC HEX JAM NUT	1
5	BT5840	5/8-11UNC X 4in LONG HEX HEAD BOLT	1
4	RBH1413	BOLT RING (MOD A) 5-16G 13GA 5/8 LUG	1
3	GE0503-01	GASKET 3/8 DIA RD EPDM	1
2	P1409	COVER 14 ID	1
1		BODY/BOTTOM 5 GALLON DRUM 14 ID	1

Figure 2. Design drawing of the 5-gallon drums to be used for SNM storage.

Description of storage drums and proposed storage layout

A nominal quantity of 312 grams of fissile AGN-201M fuel has been modeled in one of these drums under the following conditions:

- in air and reflected by 12" of concrete, and
- reflected by 12" of water and by 12" of concrete.

The results are presented in the following table. An additional calculation for 9 fuel plates (as described in the SAR and discussed in the November 18, 2015 response to RAI item 1) in a single right cylindrical stack, reflected by 12" of water and 12" of concrete was also performed with a resulting k_{eff} = 0.8945. This result approximates the outcome of stacking two drums containing all of the AGN-201M fuel plates without an air gap.

The reactivity calculations performed represent very conservative bounding estimates, as demonstrated by an estimate of the reactivity of the nine fuel plates in the AGN-201M reactor with all control rods inserted. The resulting reactivity value (k_{eff} = 1.0760) is very conservative relative to the excess reactivity margin described in the Safety Evaluation Report (k_{eff} = 1.005), and is the result of simplifying assumptions used for the SCALE/KENO-VI calculations. This includes using a fuel concentration averaged over the external volume of the stacked fuel plates without modeling the voids for control rod drive mechanisms and the glory hole penetration.

Scenario #	configuration	k_{eff}	+/-
1	312 g fuel in can, 12" air	0.5339	0.0018
2	312 g fuel in can, with 12" water +12" concrete	0.6665	0.0024
3	9 fuel plates, single stack, 12" water + 12" concrete (represents stacked drums)	0.8945*	0.0023
TEST	≈ 665 g fuel (all control rods inserted) in Al core tank, with graphite reflector, lead shield, Fe reactor tank, and water-filled Fe outer shield tank	1.0760	0.0019

** The Hazard Summary Report for the AGN-201 reactor predicts a 5% to 10% reduction in reactivity from a nominal 2" air gap between the upper and lower core halves. (ANL-6510, page 9).*

Given the stacked drums have the potential to exceed the reactivity limit of k_{eff} = 0.8 specified in Technical Specification 5.6, item 1, the two drums will be placed in opposite corners of the NSC fuel storage vault with and secured to the lower TRIGA fuel storage tubes (empty) using cable, chain, or similar methods, and locked.

Horizontal spacing of the two drums has been further evaluated using the solid angle assessment method presented in TID-7016, Rev 2, Nuclear Safety Guide. Using a conservative k_{eff} of 0.7 and the nominal drum dimensions, the allowed solid angle must be <2 steradians and is met with the drums even at very close distances (e.g., with an air gap < 1 foot). A revised proposed minimum center-to-center separation distance of 10 feet is sufficient to consider the storage drums uncoupled for nuclear safety considerations and allows flexibility for drum inspections.

Figure 3 illustrates the proposed positions of SNM-bearing components in the NSC fuel storage vault, with the exception of the ^{239}PuBe source. To maintain personnel exposures ALARA, this source will be stored in a neutron-attenuating shield and placed in a location within the fuel storage vault, as approved by site Radiation Safety Officer.

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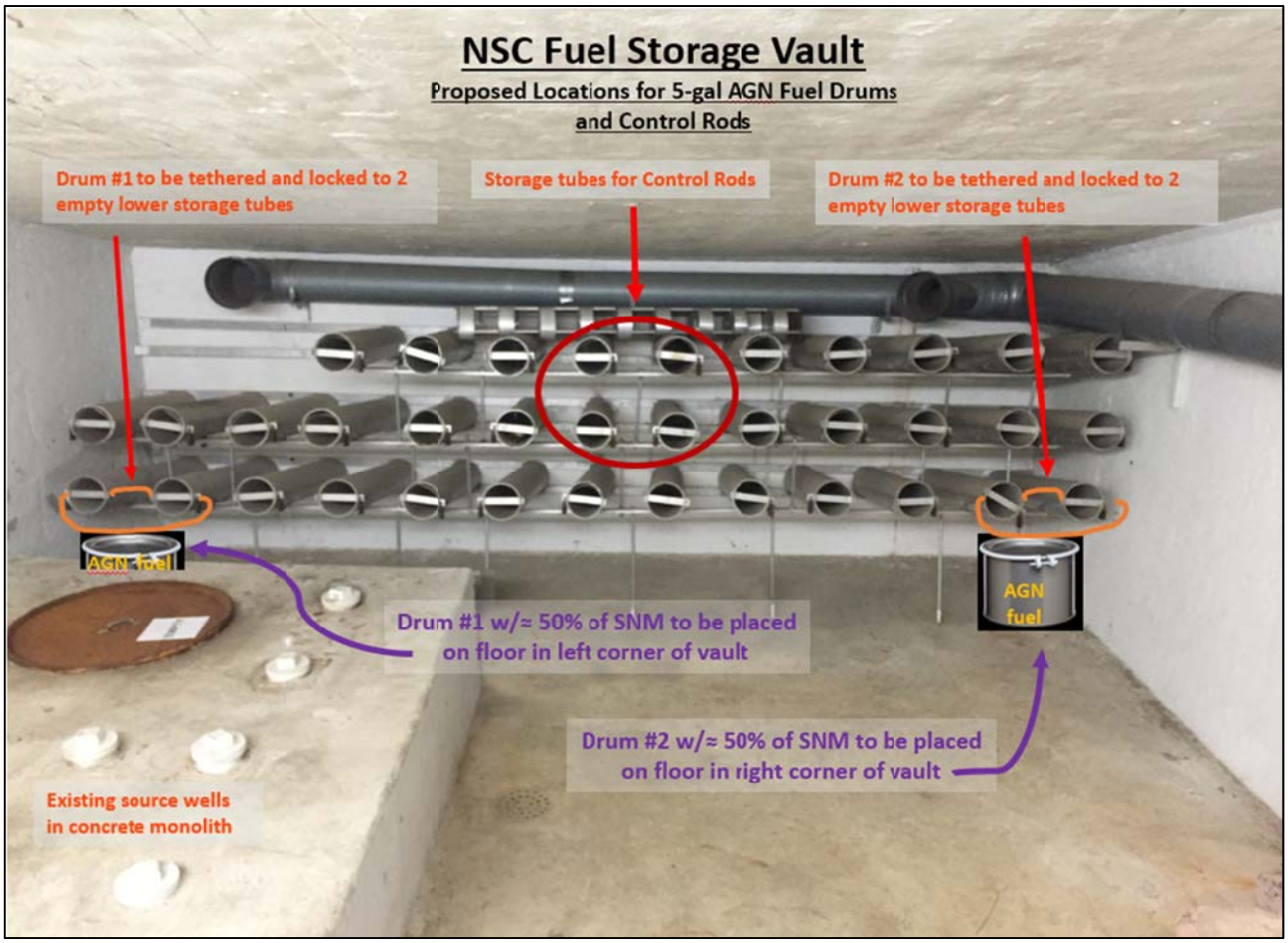

Figure 3. Photograph of the NSC fuel storage vault where the AGN-201M SNM will be stored.

Authorization to possess AGN-201M byproduct material

The request to possess AGN-201M components under NSC Facility Operating License R-83 is to explicitly authorize fission products and activation products as may be present in the irradiated AGN-201M fuel, ^{239}PuBe startup source, fuel-bearing control rod ends, and activation products contained in the startup source capsule and the mechanical portions of the control rod assemblies. This request does not have a parallel request to remove the byproduct material possession in the AGN-201M Facility Operating License R-23, as it is TAMU's intent to retain possession of other activated components (e.g., the water shield tank and its contained component) under R-23 during storage at the NSC site.

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THE FOLLOWING PAGES INCLUDE THE ORIGINAL AND PROPOSED

REPLACEMENT PAGES FOR THE LICENSE AND

TECHNICAL SPECIFICATIONS

Enclosure 1A

TEXAS ENGINEERING EXPERIMENT STATION/TEXAS A&M UNIVERSITY SYSTEM DOCKET NO. 50-128
FACILITY OPERATING LICENSE
License No. R-83

A. This license applies to the Texas Engineering Experiment Station/Texas A&M University System Nuclear Science Center [herein "the facility"] TRIGA-type nuclear research reactor owned by the Texas Engineering Experiment Station/Texas A&M University System [herein "the licensee"], located on the campus of Texas A&M University at College Station, Texas, and described in the licensee's application for license renewal, dated February 27, 2003, as supplemented.

B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses the Texas Engineering Experiment Station/Texas A&M University System as follows:

1. Pursuant to subsection 104c of the Act and 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," to possess, use, and operate the facility as a utilization facility at the designated location in accordance with the procedures and limitations described in the application and set forth in this license.

2. Pursuant to the Act and 10 CFR Part 70, the following activities are included:

   a. to receive, possess, and use, but not separate, in connection with the operation of the facility, up to 15 kilograms of contained uranium-235 enriched to less than 20 percent in the form of TRIGA-type reactor fuel;

   b. to receive, possess, and use, but not separate, in connection with the operation of the facility, up to 40 grams total of special nuclear material, of any enrichment, in the form of detectors, fission plates, foils, and solutions; and,

   c. to receive, possess, and use, but not separate, in connection with the operation of the facility, such special nuclear material as may be produced by the operation of the facility.

3. Pursuant to the Act and 10 CFR Part 30, the following activities are included:

   a. to receive, possess, and use, in connection with the operation of the facility, a sealed antimony-beryllium neutron startup source,

   b. to receive, possess, and use, in connection with the operation of the facility, a sealed 2.5-curie americium-beryllium neutron source; and,

   c. to receive, possess, and use, in connection with operation of the facility, such byproduct material as may be produced by operation of the reactor, which can not be separated except for byproduct material produced in reactor experiments.

4. Pursuant to the Act and 10 CFR Part 40, "Domestic Licensing of Source Material," to receive, possess, and use in connection with operation of the facility, not more than 6.8 kilograms of source material.

Enclosure 1B

PROPOSED LICENSE CHANGE FOR THE NSC FACILITY

TEXAS ENGINEERING EXPERIMENT STATION/TEXAS A&M UNIVERSITY SYSTEM DOCKET NO. 50-128
FACILITY OPERATING LICENSE
License No. R-83
As Amended Through Amendment No. XX

A. This license applies to the Texas Engineering Experiment Station/Texas A&M University System Nuclear Science Center [herein "the facility"] TRIGA-type nuclear research reactor owned by the Texas Engineering Experiment Station/Texas A&M University System [herein "the licensee"], located on the campus of Texas A&M University at College Station, Texas, and described in the licensee's application for license renewal, dated February 27, 2003, as supplemented.

B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses the Texas Engineering Experiment Station/Texas A&M University System as follows:

1. Pursuant to subsection 104c of the Act and 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," to possess, use, and operate the facility as a utilization facility at the designated location in accordance with the procedures and limitations described in the application and set forth in this license.

2. Pursuant to the Act and 10 CFR Part 70, the following activities are included:

   a. to receive, possess, and use, but not separate, in connection with the operation of the facility, up to 15 kilograms of contained uranium-235 enriched to less than 20 percent in the form of TRIGA-type reactor fuel;

   b. to receive, possess, and use, but not separate, in connection with the operation of the facility, up to 40 grams total of special nuclear material, of any enrichment, in the form of detectors, fission plates, foils, and solutions; and,

   c. to receive, possess, and use, but not separate, in connection with the operation of the facility, such special nuclear material as may be produced by the operation of the facility.

   d. **To receive, possess, but not use up to 0.7 Kilograms of contained Uranium-235 as AGN-201M <20% enriched ^{235}U reactor fuel, and actinides and activation products for up to 5 years from the date of issuance of license amendment xx.**

   e. **To receive, possess, but not use up to 0.020 kilograms of ^{239}Pu as a ^{239}PuBe sealed neutron start-up source in connection with storage of the AGN-201M reactor for up to 5 years from the date of issuance of license amendment xx.**

Date-2016

3. Pursuant to the Act and 10 CFR Part 30, the following activities are included:

   a. to receive, possess, and use, in connection with the operation of the facility, a sealed antimony-beryllium neutron startup source,

   b. to receive, possess, and use, in connection with the operation of the facility, a sealed 2.5-curie americium-beryllium neutron source; and,

   c. to receive, possess, and use, in connection with operation of the facility, such byproduct material as may be produced by operation of the reactor, which cannot be separated except for byproduct material produced in reactor experiments.

   d. to receive, possess, but not use, byproduct materials including contaminated or activated AGN-201M reactor components for up to 5 years from the date of issuance of amendment xx.

Date-2016

Enclosure 2A

CURRENT TECHNICAL SPECIFICATION FOR THE TEES NSC FACILITY

The current NSC reactor Technical Specification affected is Section 5.6 titled, “Fuel Storage” which follows. The proposed new Technical Specification has a vertical line indicating the changes made to the existing Technical Specification:

5.6 Fuel Storage

Applicability

This specification applies to the storage of reactor fuel at times when it is not in the reactor core.

Objective

The objective is to ensure that fuel that is being stored will not become critical and will not reach an unsafe temperature.

Specification

1. All fuel elements and fueled devices shall be stored in a geometrical array for which the k-effective is less than 0.8 for all conditions of moderation and reflection.

2. Irradiated fuel elements and fueled devices shall be stored in an array, which will permit sufficient natural convection cooling by water or air such that the fuel element or fueled device temperature will not exceed design values.

Basis

The limits imposed by Specifications 5.6.1 and 5.6.2 are conservative and ensure safe storage.

Enclosure 2B

Proposed Technical Specification Change

TEES recommends the following replacement Technical Specification change containing wording to support this LAR is as follows:

5.6 Fuel Storage

Applicability

This specification applies to the storage of reactor fuel at times when it is not in the reactor core. **This includes the combined ^{235}U fissile mass of no more than 0.7 kilograms, actinides and activation products, and the ^{239}PuBe neutron start-up source with a ^{239}Pu fissile mass of no more than 20 grams, from the TAMU AGN-201M reactor.** Date-2016

Objective

The objective is to ensure that fuel that is being stored will not become critical and will not reach an unsafe temperature.

Specification

1. All fuel elements and fueled devices shall be stored in a geometrical array for which the k-effective is less than 0.8 for all conditions of moderation and reflection.

2. Irradiated fuel elements and fueled devices shall be stored in an array, which will permit sufficient natural convection cooling by water or air such that the fuel element or fueled device temperature will not exceed design values.

3. **Possession of the AGN-201M fuel, and actinides and activation products and neutron start-up source is restricted to receipt, possession, but not use in the operation of the NSC reactor. Specification 2, above, is not applicable to these materials.** Date-2016

Basis

The limits imposed by Specifications 5.6.1, 5.6.2, **and 5.6.3** are conservative and ensure safe storage. Date-2016